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Radio Frequency Identification (RFID) in medical environment: A novel modulation technique with minimal interference properties

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Introduction

Healthcare is expected to become one of the most significant areas for RFID systems. Because of the possibility of contact-free identifying and tracking, the RFID technology improves patient safety and reduces considerably costs and medication errors by tracing of medical equipment and medication.
However, the application of RFID and other wireless communication systems has the potential to cause harmful electromagnetic disturbances on sensitive medical devices, which poses a risk for the patients.

Methods

Due to the reasons of such hazardous incidents we developed a new modulation scheme based on a frequency modulation (FM), where the instantaneous frequency is varied by the first derivative of a Gaussian impulse.
In order to demonstrate the enhanced interference properties of our Gaussian Derivative FM (GDFM) method, we compare different modulation schemes. This is done by analysing the shift of a diode characteristic depending on modulation, frequency and power.

Results

During the measurements we impose a continuous wave (CW) as a reference, as well as modulated signals like On-Off-Keying (OOK) and the GDFM on our testing circuit. The performed power is 0 dBm (1 mW) at a transmitting frequency of 100 MHz.
At a fixed current of 1.5 mA the original diode characteristic shows a voltage of 645 mV. The CW leads to 523 mV at the same current, which represents a shift of -122 mV. Nearly the same voltage of 520 mV is caused by our GDFM (-125 mV). In contrast to these values, OOK initiates the highest voltage shift of -237 mV (408 mV/ 1.5 mA) in comparison to the original characteristic.

Conclusion

The results show that conventionally RFID pulse modulation (like OOK) affects semiconductor devices like diodes the most, whereas our GDFM has an effect comparable to an unmodulated CW.
All in all, the outcome is promising for our approach regarding electromagnetic compatibility in healthcare environment.